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Too TAF towards the risk

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Abstract

During the last financial crisis the Federal Reserve launched several extraordinary actions, including the creation of a number of new facilities for auctioning short-term credit, with the general aim of sustaining the financial sector and of ensuring adequate access to liquidity to financial institutions. One of these programs has been the Term Auction Facility (TAF). The goal of this paper is two-fold. First, we study banks' liquidity and liability features depending on whether banks received credit from the TAF program. Second, we measure the impact of the program on banks liquidity risk changes. In order to achieve the first goal, we contrast liquidity distress levels in 2007:Q3 and 2010:Q4, just before the beginning and three periods after the end of the TAF program. The second goal has been attained by employing a difference in difference approach. The results suggest that, on average, banks that obtained program reserves show higher funding liquidity exposures and experience a larger reduction in liquidity risk than the other banks. Several robustness checks confirm the main results. Our findings support the view point that the TAF program was able to correctly identify banks in liquidity distress and that it was able to decrease funding liquidity risk.

Keywords TAF, Liquidity Risk, Financial Crisis

JEL Classification G21, G28, G32

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1 Introduction

The bursting of the housing bubble in 2007 led to the most severe financial crisis since the Great Depression. As banks were forced to write down billions of dollars in bad loans, the inter-bank market for short-term funding collapsed. On the one hand, this led to a deterioration of the reciprocal trust between banks so that the inter-bank market froze; on the other hand, banks with liquidity needs were reluctant to use the Fed's traditional channel of the discount window facility. Banks aversion was due to the fact that this strategy could have been interpreted by the market as a signal of being in financial trouble, therefore intensifying the pressure on the financial institution.

In this context, the Federal Reserve has been directly involved in promoting several extraordinary actions, including the creation of a number of new facilities for auctioning short-term credit, with the general aim of sustaining the financial sector and of ensuring that financial institutions have adequate access to liquidity. One of these program has been the Term Auction Facility (TAF). The TAF program was set up by the Fed in December 2007, and lasted till April 2010, when the last loans were repaid. According to the definition provided by the Fed, "[the TAF program] could help ensure that liquidity provisions can be disseminated efficiently even when the unsecured interbank markets are under stress"[1]. Via the TAF program, the Fed was injecting liquidity into the market, effectively substituting the inter-bank markets.

One relevant consequence of injecting liquidity in the market has been to affect banks funding liquidity risk. As pointed out by Taylor (2009) "The main aim of the TAF was to reduce the spreads in the money markets and thereby increase the flow of credit and lower interest rates", and, as reported by In and Maharaj (2010), "to pledge collateral that may have very little market value...[and to reduce] the LIBOR-OIS spread". This spread, according to Sarkar and Shrader (2010) " is widely used to measure interbank market stress",

[1]http://www.federalreserve.gov/monetarypolicy/files/TAFfaqs.pdf.

which we approximate by funding liquidity risk.

The goal of this paper is two-fold. First, we study banks' liquidity and liability features depending on whether they received credit from the TAF program. Second, we measure the impact of the program on banks liquidity risk changes.

Giving an answer to this set of questions is relevant in order to assess whether the program was well designed (did the reserves go to banks that really need them?), and to check how the reserves affected liquidity risk distress (did the fact of obtaining the reserves increase or decrease banks *funding liquidity* risk?).

We contrast the liquidity levels in 2010:Q4 (three quarters after the end of the program) with the levels in 2007:Q3 (one quarter before the start of the program), distinguishing between banks that received the reserves and the others. Moreover, for the banks that received the reserves we document their funding liquidity risk behaviour from twenty quarters before to ten quarters after receiving the funds. In order to assess the impact of the program on the funding liquidity risk we employ a difference in difference approach.

We find that banks that eventually benefited from the reserves exhibit higher levels of liquidity risk proxies. These measures indicate that banks with a more severe maturity mismatch were most exposed to the freezing of the interbank market and were unable to roll over their short-term liabilities during the crisis. Furthermore, we find that banks that benefited from the reserves drastically reduced their funding liquidity risk positions just after receiving for the first time the financial sustain. Previous results are also confirmed by the econometric analysis. Specifically, the findings highlight that the effect of the TAF program on the change in liquidity risk is negative and statistically significant for the following eight quarters after receiving the reserves the first time. Moreover, also the total effect of the TAF, obtained by summing up the specific quarters effect, is negative and statistically different from zero. These results are robust to the specification employed, the "Lehman effect"[2], the

[2] By limiting our sample to the pre-September 2008 auctions, we test whether our results are affected by the collapse of Lehman Brothers.

serial correlation, the uneven composition of the sample, the potential selection bias and to accountability effects[3] of the TAF program on banks balance sheets.

Our findings suggests that the program was able to target correctly the banks that really needed liquidity support[4] and that the TAF program decreased funding liquidity risk. In terms of policy implications, we identify banks that are more prone to liquidity needs, and we show that the TAF program helped to alleviate the exposure to short-term financing. One possible conclusion is that future bank regulation should not only concentrate on capitalisation, but also on measures of maturity and/or liquidity mismatches.

While previous studies analyse how the TAF program affected the liquidity risk premium, this is –to our knowledge– the first contribution focusing on volume effects of the TAF program by using micro banking data. Our approach shows several advantages with respect to that employed in previous contributions. Specifically, the micro banking perspective allows us to avoid unit root issues and therefore to mitigate problems related to the specification of the model that affect previous studies results. By employing quantities instead of prices, as pointed out by Michaud and Upper (2008) it is less likely that hidden mechanisms could affect the behaviour of the dynamics we are interested in. Moreover, by using quantities we document the banks ability in market access. As claimed by Drehmann and Nikolaou (2009) this is not the case if we used prices.

The rest of the paper is organized as follows: Section 2 contains the literature review; in Section 3 we discuss the TAF program and other programs in detail; the econometric model, the data set and the estimation methodology is presented in Section 4; in Sections 5 and 6 we show and discuss the results; finally, Section 7 concludes.

[3]Since TAF loans have to be included as short-term liabilities in banks balance sheets, we could capture spurious effects due to temporary modifications of the composition of the balance sheets of the banks if we analyse the effect of the program when it is still operated.

[4]We believe the Fed had in mind a particular set of banks when it set up the facility. The Fed wanted to help banks that had no longer access to the interbank market and intended to help them. We call those banks the "targeted" ones.

2 Literature Review

The effectiveness of the TAF program can be analysed from different perspectives. As the goal of the TAF program was to inject liquidity into the inter-bank market, previous contributions have focused on aggregate spreads measuring liquidity risk.

Taylor and William (2008a) approximate the liquidity risk premium by the spread between the London Interbank Offered Rate (LIBOR) and the overnight indexed swap (OIS). The level of the spread is regressed on a set of explanatory variables and dummy variables capturing the TAF bid submission rates. They find that the TAF dummies have no statistically significant impact on the spread.

McAndrews, Sarkar and Wang (2008) replace the spread level by its first difference in the specification employed by Taylor and William (2008a). The motivation for this choice is that liquidity premium changes are not temporary and they can persist once the TAF auction is over. The main finding is that the TAF program decreases the liquidity risk premium. However, as pointed out by Taylor and William (2008b), these results are not robust to the period and to the specific TAF auction selected.

Wu (2008) improves previous specifications in several ways. On the one hand, a new set of explanatory variables is added in order to take exchange rate, stock and bond volatilities and mortgage default risk factor into account. On the other hand, the dummy variables capturing TAF effect have been redefined, based on the assumptions that the TAF program has a permanent effect and that the level of LIBOR-OIS spread is not persistent. It has been found that TAF program decreases both the 1-month and 3-months LIBOR-OIS spreads. Taylor and William (2008b) show that Wu's results are not robust because they depend on the sample period chosen. Another weakness of Wu's findings refers to the hypothesis about the permanent effect of the TAF program and the fact that the LIBOR-OIS spread is not persistent. Taylor and William show that neither of these assumptions hold.

Cui and Maharaj (2008) distinguish between short run and long run TAF effect. They find that LIBOR-OIS spread decreases when the TAF is announced, but TAF effect is not maintained over time. Moreover, they also find that TAF only affects 3-month spreads.

Sarkan and Shrader (2010) study the impact of TAF changes on 3 month-LIBOR over OIS spread changes by augmenting the specification employed by Taylor and William (2008a). They find that changes in the TAF amount have a negative impact on the changes in LIBOR-OIS spread. Moreover, they find that spread changes depend on the magnitude of the reserves amount provided.

Christensen, Lopez and Rudebusch (2009) employ an alternative approach to estimate the effects of the TAF program. Specifically, they estimate a six-factor arbitrage-free model based on Nelson and Stiegel (1987) yield curve. They find that the TAF program lowers the 3-month LIBOR over T-bill spread by 80 basis points. Therefore, TAF program has a significant effect on decreasing liquidity premium. However, as pointed out by Thornton (2010), the LIBOR factor employed in previous contribution is based on the spread between the LIBOR and AA-rated financial corporate bonds. These spreads are highly correlated with risk spreads, therefore the results by Christensen et al. are not robust to the inclusion of the risk premium on financial bonds. Specifically, it is shown that the impact of TAF program on decreasing the LIBOR/T-bill is small or not relevant once the risk premium is included in the specification. According to this stand of the literature the effect of TAF program on liquidity risk premium is not clear: results depend on the period taken into account, on the variables included in the specification and on how the TAF program variable is modelled. The main results are summarized in the table below.

Our contribution shows several differences with respect to previous studies. To our knowledge, this is the first contribution that focuses on micro banking data, instead of aggregate data. It follows that we do not incur in potential time series issues that affect previous studies. Moreover, this choice allows us to perform a more precise analysis of the impact of the TAF program on liquidity risk.

Table 1: TAF effect on liquidity risk premium

	Features	**TAF effect**
Taylor and William	spread at level	no effect
McAndrews et. al.	change in spread	negative
Wu	persistent TAF effect	negative
In et. al.	SR and LR effect	(SR only) negative
Christensen et. al.	factor analysis	negative
Thornton	factor analysis	no effect
Sarkan and Shrader	4 periods and TAF amounts	negative

Furthermore, we focus on banks *funding liquidity* instead of *market liquidity*[5]. Specifically, we concentrate on the effect of TAF program on quantities instead of on prices (interest rate spreads). The reason is that prices are also impacted by other factors (e.g. see Michaud and Upper, 2008). Furthermore, during the financial crisis interest rates rose due to increased uncertainty and higher dispersion of credit quality. Finally, as stressed by Drehmann and Nikolaou (2009) "But most importantly, the spread between interest rates in the interbank market and a risk free rate is purely a price measure and it does not reveal anything about market access, which maybe severely impaired during crisis, nor the volume of net-liquidity demand [...]."

We focus on both short-run and long-run effects of the TAF program. Short-run analysis provides a close picture of the ongoing effects of the TAF program on liquidity exposures. However, the short-run analysis does not allow us to control for potential accounting effects affecting banks balance sheets. By employing a long-run perspective we "neutralize" this side effect of the TAF program on banks balance sheets. Finally, our results, contrary to previous studies findings are confirmed by several robustness checks.

This study has features in common also with the literature that studies the impact of the last financial crises on bank and firms behaviour during the last financial crisis. Ivashina and Scharfstein (2010) analyse the behaviour of new loans and new lending for real investment.

[5]This distinction has been clarified by Brunnermeier and Pederson (2008).

They find that banks with a better access to deposit financing cut their lending less. Finally, they also show the link between credit vulnerability, based on co-syndication with Lehman Brothers, and banks lending activity.

This contribution shares also some analogies with the study of Campello et. al. (2009) who study the corporate spending plans during the 2008 financial crises depending on credit constraints. and with the contribution of Campello et. al. (2010) who assess instead how firms managed liquidity during the financial crisis. They show that credit lines absorbed the impact of the financial crisis on corporate spending.

With respect to this stand of the literature our contribution is different because we employ an alternative benchmark to identify banks type, we focus on different periods and we address different issues.

Finally, this contribution shares important features with a study of Puddu and Waelchli (2011) where the impact of TAF program on the composition of banks balance sheets is analysed. They find that banks that benefited from the program reserves decrease portfolio risk more than the other banks. In particular, banks that received the reserves increased the share of moderately risky assets while they decrease other type of assets (not risky, risky and extremely risky). Several robustness checks confirm the main results.

3 Fed Facilities during the last financial Crisis

During the last financial crisis the Federal Reserve launched several extraordinary actions, including the creation of a number of new facilities for auctioning short-term credit, with the general aim of sustaining the financial sector and of ensuring adequate access to liquidity by financial institutions. In this section, we analyse in detail the TAF program as well as other programs launched by Fed during this period in order to underline their common points and their main differences.

3.1 Term Auction Facility program: how it works

According to the definition given by the Federal Reserve (Fed) "the TAF is a credit facility that allows a depository institution to place a bid for an advance from its local Federal Reserve Bank at an interest rate that is determined as the result of an auction"[6]. The aim of the TAF was to compensate for the collapse of the short-term funding market, by ensuring liquidity provisions when the inter-bank credit markets were under stress.

All banks that were in sound financial conditions[7] at the moment of the auction and during the term of TAF loans were eligible for the TAF. The reserves provided in the TAF program had maturity terms between 13 to 85 days[8], and they had to be fully collateralized. Banks were allowed to have at the same time more than one loan, so that reserves with different maturities could overlap. The information about banks receiving funds was private.

For each auction the Fed fixed the total amount to supply, the maximum amount a bank was allowed to obtain, and the minimum bid interest rate (r_{Fed}). For each auction, eligible banks had the possibility to make two rate-amount offers. Specifically, the bid was characterized by the amount asked by the bank and a repayment interest rate. Bids were ordered according to the repayment interest rate bidden ($r_{Bank\,i}$). The Fed then began to accept the bids starting from that associated with the highest interest rate. It would continue to do so until the offered amount was reached, or all the bids were accepted. In the former case, the interest rate that had to be paid by all successful bidders was determined by the stop-out rate, i.e. by the interest rate of the last accepted bid. If the supply exceeded the demand, the equilibrium interest rate would simply be equal to the minimum bid rate. The equilibrium interest rate r^* is therefore

[6]http://www.federalreserve.gov/monetarypolicy/taffaq.htm

[7]This definition is opaque in the sense that there are not details about it. The soundness of a particular bank has to be certified by its local Reserve Bank. It refers to bank solvency, liquidity, and profitability.

[8]The majority of the loans had a maturity of 28 or 84 days.

$$r^* = \begin{cases} r_{Fed} & \text{if } Supply > Demand \\ \widehat{r}_{Bank\,i} & \text{if } Supply \leq Demand \end{cases} \quad (1)$$

where $\widehat{r}_{Banki}$ is the lowest interest rate that was accepted by the Fed.

The main goal of the TAF program was to inject liquidity in the inter bank credit market, by providing financial support to banks in liquidity distress. A normal way of proceeding, with banks asking for a loan at a normal discount window rate to the Fed, would have generated a signalling issue. This is one of the reasons that convinced the Fed to provide reserves in the TAF program by an auction system[9]. The "stigma effect" during the last financial crisis has been discussed and measured by Armantier et. al. (2011) by using TAF program banks bids. They find that in the third quarter of 2008 banks preferred to pay on average at least 34 basis points more to borrow from the TAF program than from the discount window.

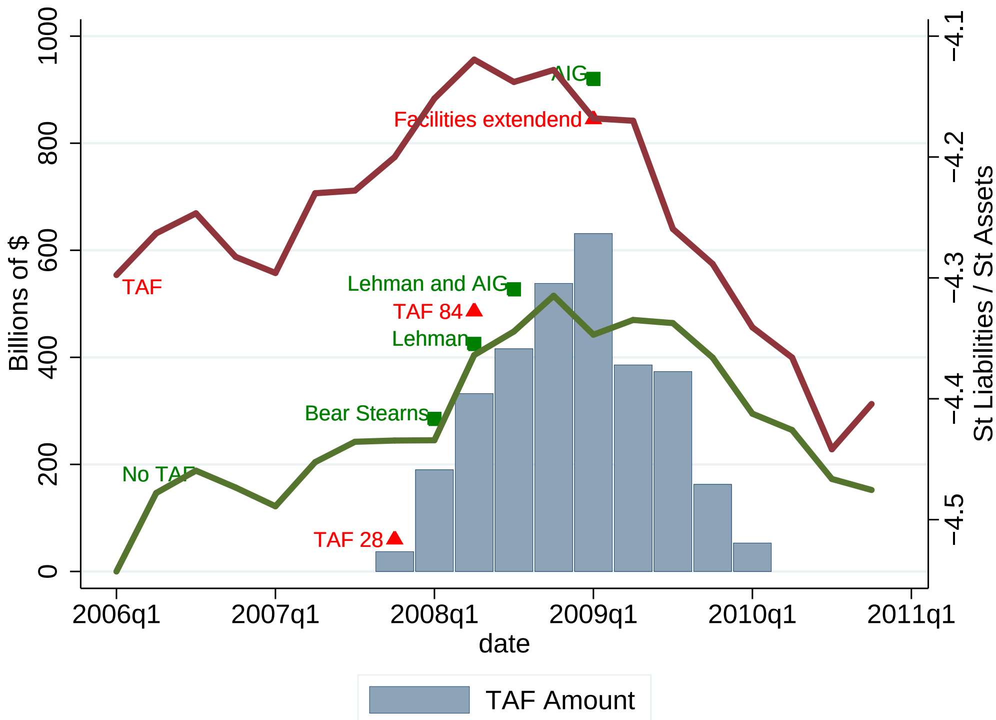
Assuming that the Fed has no interest in making profits by the implementation of these sort of programs[10], designing a system of financial sustain, based on auctions, has several important advantages in decreasing the potential stigma effect: the interest rate is determined through a market mechanism instead of being imposed by the authorities, the banks approach the Fed collectively instead of individually, and the information concerning the auction is private.

Figure 1 depicts the evolution over time of the amount of reserves provided in each quarter. Moreover, several market events (squares) and policy measures related to the TAF program (triangles) are reported. The program was announced on December 12, 2007. Specifically,

[9] Armantier et. al. (2008) and Armantier et. al. (2011).

[10] This was actually the case. A circumstantial evidence in support of this claim is that the minimum interest rate fixed by the Fed during the auctions related to the TAF program was always lower than the official discount window rate, even if the participation to the TAF program was private information. This fact would implied that banks had to pay a premium for this, but this was not the case.

Figure 1: TAF facilities, market events, policy measures and liquidity risk



the initial reserves had a maturity of 28 days. The amount provided was increased in the first quarter 2008, after Fannie Mae and Freddie Mac requirements were eased to allow for increases in lending and Bear Stearns received emergency loans from the Fed. Only in 2008:Q2, after Lehman Brothers reported a loss of \$2.8b, reserves with longer maturities were established. The amount of reserves provided kept rising after Lehman Brothers' bankruptcy and the downgrade of AIG debt. The maximum amount was supplied during 2009:Q1, when Fannie Mae and Freddie Mac reckoned a need of \$51b to continue operations and AIG announced large losses. From 2009:Q2 on, new facilities decreased and lasted until March 8, 2010, when the last auction took place.

3.2 Other facilities

In March 2008 two additional programs have been launched by the Fed. The first one was the Term Securities Lending Facility (TSLF). It was a weekly loan facility, with the aim of promoting the functioning of financial markets, by offering "Treasury general collateral (GC) to the Federal Reserve Bank of New York's primary dealers in exchange for other program-eligible collateral"[11]. Its maturity term was of 28 days. The main difference between the TSLF and the TAF lies in the fact that the former offered Treasury GC to the New York Fed's primary dealers in exchange for other program-eligible collateral, while the latter offered term funding to depository institutions based on a auction system.

The second program opened in March 2008 was the Primary Dealer Credit Facility (PDCF). As the previous program its goal was to promote the functioning of financial markets by providing funding to the primary dealer through overnight loan facilities in exchange for any tri-party-eligible collateral. The difference of this program with respect to the TAF program refers to the maturity term of the loan (one day versus 28 or 84 days) and to the type of mechanism employed for allocating the funds (exchange versus auction).

Three other programs, less related to the TAF program but nevertheless important, have been initiated by the Fed between October and November 2008. The Commercial Paper Funding Facility (CPFF) had the goal "of enhancing the liquidity of the commercial paper market by increasing the availability of term commercial paper funding to issuers and by providing greater assurance to both issuers and investors that firms will be able to roll over their maturing commercial paper"[12].

The Money Market Investor Funding Facility (MMIFF) was a complement program of the CPFF. It "provided senior secured funding to a series of special purpose vehicles established by the private sector (SPVs) to finance the purchase of certain money market instruments

[11] http://www.newyorkfed.org/markets/tslf_faq.html

[12] http://www.newyorkfed.org/markets/cpff_faq.html

from eligible investors"[13]. The main idea behind this program was to accommodate credit needs of businesses and households by improving the access to term financing from money market investors to banks and other financial intermediaries.

Finally, the Term Asset-Backed Securities Loan Facility (TALF) has been designed "to increase credit availability and support economic activity by facilitating renewed issuance of consumer and business asset-backed securities at more normal interest rate spreads. Under the TALF, the New York Fed will provide non-recourse funding to any eligible borrower owning eligible collateral"[14].

In this paper, we focus on the TAF program for several reasons. The first argument refers to the availability of the data. Second, the TAF program was different with respect to previous ones in the way it was built. It is interesting to assess whether and how the auction system worked. Finally, TAF program was addressed directly to sustain financial institutions so that its analysis is of relevance to understand the impact of the program on risky behaviours of banks.

4 Empirical Evaluation

In this section we report a detailed analysis of our data set. Moreover, we summarize the main results at the glance, we present econometric model employed for answering the main questions addressed in this study and we discuss the associated potential econometric issues.

4.1 The data set

The dataset employed in this paper has been obtained by merging various datasets. The data concerning bank's balance sheet is a combination of the Report of Condition and Income (generally referred to as Call Report) and the Uniform Bank Performance Report (UBPR).

[13]http://www.newyorkfed.org/markets/mmiff_faq.html
[14]http://www.newyorkfed.org/markets/talf_faq.html

US banks are required by the Federal Financial Institutions Examination Council (FFIEC) to hand in these reports. The specific reporting requirements depend on the size of the bank and whether it has foreign offices. We accessed the Call Report data through the website of the Federal Reserve of Chicago and the UBPR data through the website of the FFIEC[15]. The period taken into account goes from 2002:Q4 to 2010:Q4 (32 quarters). The data on the TAF auctions have been obtained from the Federal Reserve Board. The sample covers the period from 2007:Q4 to 2010:Q1.

The datasets have been merged and transformed so that we work with a panel dataset quarterly based. The number of banks varies between 6989 and 8374 units, depending on the case. Among them, 279 banks obtained TAF program reserves at least once. It follows that the banks that received the reserves represent approximately 3.3% of the total number of the banks in the sample[16]. By combining the time series dimension (32 quarters) with the cross section dimension (between 6989 and 8374 banks) we deal with an overall amount of observations included between 245636 and 248243, depending on the case[17].

4.2 Description of the variables

In order to capture the TAF effect we define several variables, depending on what we want to measure. First, we generate a set of dummy variables $\tau_{i,t,\kappa}$ with $\kappa \in [0, 8]$ quarters, to assess the impact of the TAF program κ quarters after the bank i received the reserves the first time. For instance, $\tau_{i,t,\kappa=3}$ takes a value of one if bank i in period t obtained the reserves the first time three quarters before and zero otherwise.

Second, adding up the quarter specific τ dummy variables across quarters and by bank, we

[15] A known issue of the Call Report data we cannot control for, is the so-called "window dressing" effect. Specifically, the day before the report, banks adopt a virtuous behaviour so that their balance sheets look particularly good on the day of the report.

[16] In the robustness section, we control for the uneven composition of the two groups of banks characterizing the sample size.

[17] There are 67 US branches of a foreign bank and agencies of foreign banks in the TAF dataset. Since we do not have comparable balance sheet data for these banks, we exclude them from our analysis.

generate another dummy variable, $TREAT_{i,t}$, that takes value 1 if bank i received reserves in period t or in any previous period and zero otherwise. Therefore, $TREAT_{i,t}$ changes across banks and, for each bank, across time.

The two set of variables are capturing similar but different effects. Working with the τ dummy variables we assume that the impact of the reserves on the change of the dependent variable is time dependent, while using the $TREAT$ variable, we implicitly assume that the impact of the reserves is constant over time.

Finally, in the robustness check we employ another variable to distinguish banks according to the TAF program. Specifically, TAF_i is a dummy variable that takes value 1 if bank i received TAF reserves at least once, and 0 otherwise.

In all the previous cases we employ only the information referring to the fact whether and when a particular bank i obtained the reserves, disregarding other potentially useful and available information such as the number of times a generic bank i received the funds. There exist several arguments supporting our choice. First, we are interested on the effect of the TAF program on liquidity risk and not on "learning by bidding" effect[18] that could be eventually captured by the the number of times a bank benefited from the program. Second, the correlation between the change in liquidity risk and the total amount of reserves per bank assets volume measured in 2007:Q3 is $-.0141$ and statistically not significant different from zero (p-value .2174)[19] so that its contribution in explaining the liquidity risk variation would be marginal.

Due to the fact that one of the most relevant effects of the TAF program has been that of affecting banks funding liquidity risk. As primary measure of funding liquidity risk we use a bank's exposure to short-term financing needs. Specifically, our benchmark results are

[18]The "learning by bidding" refers to the learning process that banks experience when they bid repeatedly. It is similar to the "learning by investing" process described among other by Arrow (1962).

[19]This result is robust to the measure of liquidity risk. The respective numbers are (p-values in parentheses) .0040 (.7245) for short-term liabilities over total liabilities, $-.0021$ (.8560) for short-term net liabilities, and .0103 (.3782) for zero risk weight assets over short-term liabilities. The result does not change if we compute the correlations for the period 2007:Q3 - 2010:Q4.

based on the log of the short term liabilities over short term assets (*ST LIAB /ST ASS*). Larger values of this ratio implies a higher level of funding liquidity exposure. This choice is consistent with the definition provided by the Basel Committee of Banking Supervision. According to their definition liquidity is "the ability to fund increases in assets and meet obligations as they come due".

In the robustness checks we employ different measures of liquidity risk. Specifically, we focus on the log of short term liabilities to risk-free assets ratio (*ST LIAB/PF RISK* 0), the short term liabilities over total liabilities (*ST LIAB TLIAB*), and on the short term net liabilities (*ST NET LIAB*). These proxies show how important short-term liabilities are with respect to different assets and liabilities measures.

The variables employed as controls refer to liquidity capacity, banks portfolio assets composition, banks different type of loans and finally to banks loan losses, capital capacity and profitability.

As a proxy for liquidity capacity we employed two alternative measures. *CASH* is determined by cash and balances due from depository institutions over total assets, while *LIQUIDITY* is defined as the sum of total trading assets, total available-for-sale securities and total held-to-maturity securities over total assets.

Focusing on the banks portfolio assets composition we take into account the ratio of risk-weighted assets to total assets (*PF RISK*)[20]. This measure can be interpreted as a proxy of the portfolio risk: the higher this ratio, the higher the fraction of assets that are considered risky by the regulatory authorities. Moreover, we also take explicitly into account as control variables the fraction of each different category of assets consistently with Basel I accords.

We also include as explanatory variables banks loans measures. We considered total loans over total assets (*TLOANS*) as well as the ratio of different loan types over total loans. Specifically, we focus on commercial and industrial, real estate, individual and agricultural

[20]The weights (0, 20, 50 or 100%) are ascribed according to Basel I accords. On and off balance sheet items have been summed when calculating total assets.

loans ($CI\ LOANS$, $REST\ LOANS$, $INDIV\ LOANS$ and $AGRI\ LOANS$, respectively).

Finally, we also consider as controls some features of the banks such as the non-performing loans over total loans ($NPTL$), defined as loans that are past due at least 30 days or are on non-accrual basis, the $BUFFER$ that is obtained by taking the difference between the tier 1 capital ratio and the minimum requirement established by the banking authorities[21], the return on assets (ROA) that is equal to the ratio of the income before income taxes and extraordinary items and other adjustments over total assets and the $SIZE$ of the bank measured by its total assets.

4.3 Main facts at a glance

In Table 3 the descriptive statistics of the variables employed in this study are reported.

We can distinguish along two dimensions. On the one hand, columns (5) and (11) refer to the average values of the variables measured in 2007:Q3 (before), just before the beginning of the program and in 2010:Q4 (after), three quarters after its conclusion. On the other hand, columns (1), (3), (7) and (9) report the variables average values by distinguishing between banks that received TAF program reserves and the others banks in each of the two periods.

Focusing on funding liquidity risk indicators only, in order to test whether there are on average differences between the before and the after periods and between the TAF and the No TAF banks we run the following regression, excluding from the specification extra explanatory variables:

$$Liq.\ Risk_{i\,t} = \alpha + \beta_1 time + \beta_2 TAF_i + \beta_3 TAF_i \times time + \epsilon_{i,\,t} \qquad (2)$$

In equation (2) the variable of interest, $Liq.Risk_{i,\,t}$, is regressed on a constant, a $time$ dummy variable that capture the time dimension (Before and After), a TAF group dummy variable

[21] In the period under analysis the minimum capital requirement was equal to 6%.

in order to take into account whether a particular bank i belongs to the the TAF or to the No TAF group, and finally an interactive dummy variable, $TAF \times time$, that captures the difference in within groups differences.

In this way we are able to analyse the following four main cases even if we are interested in the coefficient β_3 that represents the difference in within groups differences:

Table 2: Different cases

	TAF	No TAF	Diff.
After	$\alpha + \beta_1 + \beta_2 + \beta_3$	$\alpha + \beta_1$	$\beta_2 + \beta_3$
Before	$\alpha + \beta_2$	α	β_2
Diff.	$\beta_1 + \beta_3$	β_1	β_3

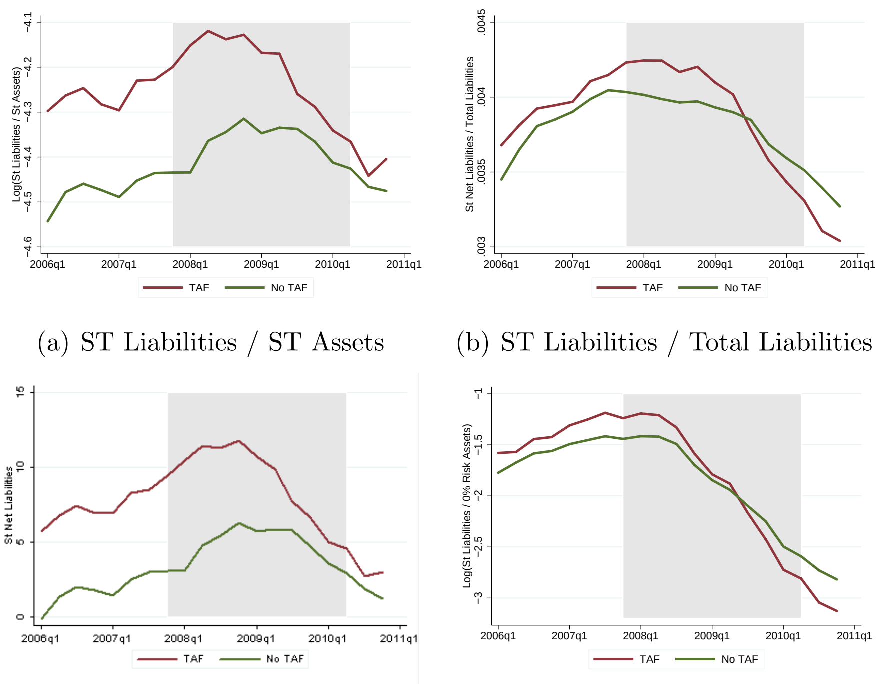
More precisely, we are interested in testing average difference within group across time and within time across groups. By fixing the bank group ("TAF" or "No TAF") we can test whether there are on average differences within the group before the beginning of the TAF program and after its conclusion. Furthermore, by fixing the time dimension (After or Before) we can test whether, on average the two groups behave differently over time.

The results are reported in Section C, Table 4 of the Appendix. The main findings highlight that before the beginning of the program (2007:Q3), TAF banks report levels of funding liquidity risk higher than the other banks, and that these differences become smaller once the program is over (columns (1), (2) and (5)). The other relevant result is that although all banks decrease their funding liquidity exposures, TAF banks did more (columns (3), (4) and (5)). $CASH$ is the only measure that does not follow this pattern. Specifically, banks that do not receive the reserves increase $CASH$ more than the other banks. An explanation for this result is that No TAF banks employ cash as a substitute of TAF reserves. In order to meet their liquidity needs they have to increase cash, given that they cannot benefit from these financial aid.

A visual counterpart of previous findings are highlighted by the graphs reported in Figure 2. The results show that banks liquidity risk levels between groups are quite different before the beginning of the program while this difference gets smaller (or reverts) after the end of the program.

The analysis of the graphs showing the patterns of the series for the TAF and No TAF banks highlight that except for the level, the two groups of banks behave in terms of liquidity risk in the same way, before the beginning of the TAF program. By taking first differences and employing a fixed effects estimation, we can control for time invariant heterogeneity, so that potential selection bias is avoided.

Figure 2: Liability and liquidity banks group behaviour (per-quarter-per-group averages)



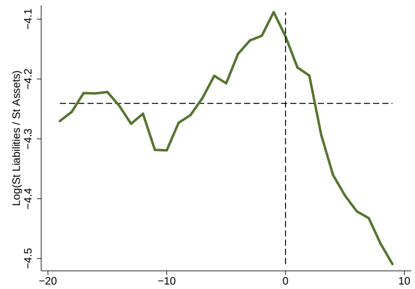
(a) ST Liabilities / ST Assets

(b) ST Liabilities / Total Liabilities

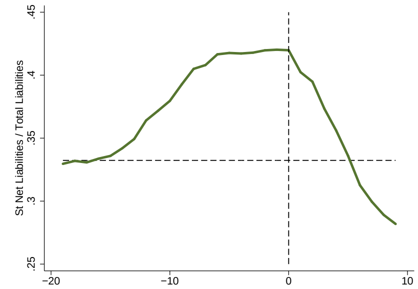
(c) ST Net Liabilities / Total Assets

(d) ST Liabilities / PF Risk 0%

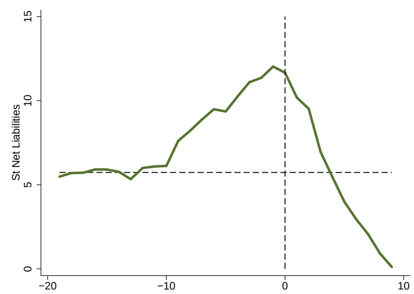
Figure 3: TAF participation and liability and liquidity banks behaviour (per-quarter averages)



(a) ST Liabilities / ST Assets



(b) ST Liabilities / Total Liabilities



(c) ST Net Liabilities / Total Assets

(d) ST Liabilities / PF Risk 0%

In Figure 3, for several indicators of funding liquidity risk, the behaviour of the banks that received the reserves for the period included between 20 quarters before and 10 quarters after the first time they received the reserves. The graphs are quite informative: for all measures of liquidity risk, banks decrease their funding liquidity risk positions once they received the reserves. Again, this indicates that the TAF program was effective.

The descriptive analysis highlights that both groups of banks adjust the quantities that refer to liquidity risk. This is true by looking at liabilities and liquidity indicators. Moreover, in the majority of the cases TAF banks change these amount more than the No TAF banks. These changes imply as well that the differences between groups are smaller or disappear once the program is over. Summing up, the banks that received the reserves were apparently the banks for whom the program has been designed.

Table 5 reports the pairwise correlation between the log of short term liabilities over short term assets, the alternative measures of liquidity risk and the main controls employed in the econometric analysis of this study, measured in 2007:Q3. The correlations with the alternative measures of liquidity risk are positive and range between .238 (for short term liabilities over risk-free assets) and .901 (for the short term net liabilities). Focusing on the additional regressors, we have a negative correlation between the log of short term liabilities over short term assets and $CASH$ ($-.187$) and $BUFFER$ ($-.362$), while the correlation with $PF\ RISK$, although it is negative is quite small around $-.043$. The correlation between net liabilities and the rest of the variables, $SIZE$ (.200), $TOTLOANS$ (.137), ROA (.061) and $NPTL$ (.0339) are positive even if the correlation coefficients show a lot of variability.

4.4 The econometric model

In order to assess the impact of the TAF program on banks liquidity risk we employ a difference in difference approach. Specifically, the baseline model takes the following form:

$$\Delta\, Liq.\, Risk_{i,\,t} = \alpha_i + \phi_0\, Liq.\, Risk_{i,\,t-1} + \Phi X_{i,\,t-1} + \tau_{i,\,t,\,\kappa} + \delta_t + \epsilon_{i,\,t} \tag{3}$$

where Δ is the time difference operator, $Liq.\, Risk_{i,t-1}$ is the previous period level of liquidity risk, $X_{i,\,t-1}$ is a vector of explanatory variables, $\tau_{i,\,t,\,\kappa}$ are quarter-TAF effect dummies, α_i are bank dummies, δ_t are quarter dummies and $\epsilon_{i,\,t}$ is the error term.

The model in equation (3) is estimated by using fixed effects, clustering the observations by banks to address serial correlation. Even if we work with a dynamic panel, it is possible to estimate the model by using fixed effects because the time dimension of the panel is high enough (18 periods) so that we do not incur into inconsistent estimates[22].

[22] If this was not the case, we would estimate the model using Arellano-Bond technique based on a GMM estimator.

The previous model can be modified by replacing the quarter-TAF effect dummy variables by $TREAT_{i,t}$. This alternative measure of the TAF effect takes value one if bank i obtained the reserves the first time and zero otherwise. The alternative specification takes the following form:

$$\Delta\, Liq.\, Risk_{i,\,t} = \alpha_i \,+ \phi_0\, Liq.\, Risk_{i,\,t-1} \,+ \Phi X_{i,\,t-1\,,j} + \beta\, TREAT_{i,\,t} \,+ \delta_t \,+ \epsilon_{i,\,t} \tag{4}$$

In the context of this study, a potential issue that can affect the results refers to the selection bias. This problem may arise because banks that received the reserves have unobservable features such that they are ex ante different compared to the rest of banks. As discussed before self selection is a minor issue so that the baseline results refer to estimations based on an unmatched sample. Furthermore, in the robustness checks we control for this potential problem by employing a matched sample[23] and by using the treatment model with a binary dependent variable.

5 The Model

According to equations (3) and (4), the estimated models take the following forms:

$$\begin{aligned}\Delta\, ST\ LIAB/ST\ ASSETS_{i,\,t} = \alpha_i + \phi_0\, ST\ LIAB/ST\ ASSETS_{i,\,t-1} + \tau_{i,\,t,\,\kappa} + \delta_t + \\ \phi_1\, BUFFER_{i,\,t-1} + \phi_2\, SIZE_{i,\,t-1} + \phi_3\, CASH_{i,\,t-1} \\ \phi_4\, PF\ RISK_{i,\,t-1} + \phi_5\, NPTL_{i,\,t-1} + \phi_6\, ROA_{i,\,t-1} + \epsilon_{i,\,t}\end{aligned} \tag{5}$$

[23]Using the matching approach to control for potential selection bias opens other issues about the variables to take into account to match the two groups of banks.

and

$$\Delta\, ST\ LIAB/ST\ ASSETS_{i,t} = \alpha_i + \phi_0\, ST\ LIAB/ST\ ASSETS_{i,t-1} + \lambda_0\, TREAT_{i,t} \qquad (6)$$
$$+ \delta_t + \phi_1\, BUFFER_{i,t-1} + \phi_2\, SIZE_{i,t-1} + \phi_3\, CASH_{i,t-1} +$$
$$+ \phi_4\, PF\ RISK_{i,t-1} + \phi_5\, NPTL_{i,t-1} + \phi_6\, ROA_{i,t-1} + \epsilon_{i,t}$$

The τ dummy variables are expected to be negative and statistically significant, the same is true for the variable $TREAT$. Our hypothesis about the relationship between the TAF program and the change in the liquidity risk is supported by the argument that banks with liquidity needs that want to participate to the TAF program[24] have to cut more their liquidity exposures in order to be eligible for future auctions. Therefore, they were forced to adopt a behaviour, in terms of funding liquidity risk, more virtuous than that exhibited by the rest of the banks.

The lag level of the $ST\ LIAB/ST\ ASSETS$ has been included in order to measure the impact of the ex ante levels of liquidity risk on the change in the liquidity risk. We expect that the higher the lagged liquidity risk level is, the larger is the change. The worse the ex ante position, the more relevant is the reduction of the liquidity risk exposure.

In equations (5) and (6) we also include a set of additional explanatory variables. Specifically, we add the lagged values of $CASH$, $BUFFER$, ROA and $SIZE$. By including the cash over total assets ratio we want to capture potential liquidity distress associated with banks liquidity needs. High level of cash are expected to reduce the change of the liquidity risk.

$BUFFER$ is defined as the difference between the tier 1 capital ratio and the minimum requirement established by the banking authorities. Its inclusion in the specification is useful for assessing the impact of capital cushions on the change of liquidity risk. More precisely,

[24] The TAF program could be interpreted as a repeated game.

we expect that higher buffer implies that banks are more prone to adopt more aggressive investment strategy. It follows that banks face an increase in risk.

ROA, the return on assets, measures the investment efficiency. Therefore, the effect of ROA on the change in funding liquidity risk is expected to be negative.

Larger banks, in terms of assets, are more prone to undertake riskier behaviours. Therefore, $SIZE$ is expected to positively affect the change in the liquidity risk exposure.

Finally, in the baseline model we also include the lagged values of $NPTL$ and $PF\ RISK$, in order to capture the impact of current distress due to bad loans on liquidity risk and of the portfolio risk level on the change of funding liquidity risk. More precisely, higher lagged level of $NPTL$ can force banks to take future riskier strategies, specifically, banks may be tempted to undertake a gambling for resurrection strategy[25]. Therefore, higher level of $NPTL$ implies positive changes in funding liquidity risk. We do not have a priori expected sign for the effect of the portfolio risk on the change of funding liquidity risk.

Depending on the specification we replace the portfolio risk by the different types of assets ($Risk\_0_i$ $Risk\_20_i$ $Risk\_50_i$ $Risk\_100_i$) with respect to their level of risk, according to Basel I accords, and we include the ratio of total loans over total assets ($TLOANS$) as well as the relative importance of the different type of loans ($CI\ LOANS$, $REST\ LOANS$, $INDIV\ LOANS$ and $AGRI\ LOANS$), in order to capture loans composition effect on the change of funding liquidity risk. As for the asset types, we do not have a priori expected sign for the effect of these two variables on the change of funding liquidity risk.

6 Results

In this section we present the baseline results as well as the robustness checks. Finally, we discuss the main implications of our findings from a policy view point.

[25]See e.g. Kane (1989)

6.1 Baseline

The baseline results, obtained by using a difference in difference estimation are reported in Table 6, Section C of the Appendix. In column (1) the model has been estimated in its light version, including only the lagged level of the liquidity risk and the τ dummy variables. In column (2) we add a set of extra controls. Specifically, we include $BUFFER$, $SIZE$, $CASH$, ROA, $PF\ RISK$ and $NPTL$. In column (3) we replace portfolio risk by the specific assets types, according to Basel I agreement, while in column (4) we substitute assets groups by loans types held by each bank and we also include total loans over total assets. Finally, in columns (5) we replicate the estimation of column (2), but replacing $CASH$ by $LIQUIDITY$. From column (6) to column (10) we repeat the same regressions by replacing the τ dummy variables by the $TREAT$ dummy variable.

Independently of the specification, the main results do not change. The effect of the program at the impact is always statistically not different from zero, even if the estimated coefficient shows the expected sign. The other τ dummy variables show the expected sign and are statistically significant. Figure 5 provides a graphical presentation of the main results. In Figure 5.a, we report the estimated coefficients of the τ dummy variables of the baseline model (column (2)) and their correspondent standard errors.

These results are also confirmed by when we test whether the sum of the τ dummy variables is statistically different from zero. In all the cases, we can always reject the null hypothesis. The results are reported in the bottom part of table 6. The fact of receiving TAF loans has an accumulated effect on the change in the liquidity risk exposure included between $-.71$ and $-.99$. This means that banks that receive TAF reserves reduce their liquidity exposure twice as fast as the other banks.

Previous results are confirmed when we replace the τ dummy variables by the $TREAT$ dummy variable, by assuming that the effect of the program is the same in each quarter after the first time a bank obtained the reserves. In this case the average effect per quarter (overall[26]) on the change in the liquidity risk exposure is between $-.072$ and $-.089$ ($-.864$ and -1.068).

Focusing on the rest of the results, it comes out that the lagged level of the liquidity risk, has always a statically significant and negative impact on the dependent variable. This implies that higher previous levels of liquidity exposures leads to a larger contraction of liquidity risks. Also the results about $BUFFER$, $SIZE$, $CASH$, ROA, $PF\ RISK$ and $NPTL$ are statistically significant and with the expected sign in all the cases analysed. In particular, it is worth to emphasize the impact of the level of capital buffer held by banks. Its effect on the change of liquidity risk is positive. This result is consistent with the findings of studies focusing on the relationship between capital buffer and portfolio risk. Another important result refers to the non performing loans. The findings confirm our intuitions about the behaviours of the banks when the level of $NPTL$ increases. Specifically, the results suggest that banks are tempted to adopt a gambling for resurrection strategy.

Column (2) shows that portfolio risk negatively affects the change in liquidity exposures and that this effect is statistically significant. In column (3) we split up portfolio risk into the risk categories. The results highlights the positive, but diminishing effect of the different risk categories on the change in liquidity risk exposure. These findings suggest that banks with larger exposures in portfolio risk prefer to adopt a more prudent strategy in terms of liquidity risk. From this perspective it seems that portfolio and liquidity risk are complementary.

Column (4) highlights that total loans over total assets are statistically significant and negative. Instead, the types of loans do not affect the change in liquidity risk exposures.

[26] In order to make the results comparable with the sum of the τ dummy variables, we multiply the per quarter coefficient by 12.

6.2 Robustness

We perform a large number of checks in order to assess the robustness of our results. Overall we find that the results are robust to the specification employed, the "Lehman effect", serial correlation in the $TREAT$ variable, the uneven composition of the sample, the potential selection bias and to the accountability effects of the TAF program on banks balance sheets.

From the analysis of the baseline results, it follows that the findings are stable with respect to the specification employed. This is true when we employ the τ dummy variables and the $TREAT$ dummy variable.

Our result could suffer from omitted variable bias due to the fact that other events occurred contemporaneously to TAF program and which we have not been explicitly taken into account. In particular, one relevant episode was the failure of Lehman Brothers in 2008:Q3. In order to neutralize the potential "Lehman effect" we drop from our sample banks that had the majority of their credit lines co-syndicated with Lehman Brothers, as defined by Ivashina and Scharfstein (2010). The results, reported in column (8) of Table 7, document that the coefficients of the variables capturing the TAF effects are statistically significantly different from zero and show the expected negative sign. Therefore, we can conclude that the results are not driven by the "Lehman effect".

Throughout our paper we have used the log of short term liabilities over short term assets as the measure for bank liquidity risk. The literature suggests various other measures of liquidity risk, which include the fraction of short term liabilities over total liabilities, the short term net liabilities and the log of the short term liabilities over zero risk assets. The short term net liabilities are defined as short term liabilities less short term assets over total assets, and it is bounded between -100 and 100. A drawback of this measure is that given the same numerator, two banks show different net liabilities if they have different total assets. In particular, the measure is biased towards zero, so that the measurement of the funding liquidity risk could be misleading. However, the correlation between $ST\ NET\ LIAB$ and the log ratio of the short term liabilities and short term assets is .89*** so that the potential bias issue is put in perspective. Therefore, it follows that higher values reported by these indicators imply higher level of the liquidity risk. The results, reported in Table 7, compares the estimation results when different measures of liquidity risk are employed.

Column (1) reports the baseline results using the log short term liabilities over short term assets as a proxy for liquidity risk. Columns (2), (3) and (4) show the results when the alternative measures of liquidity risk are employed as dependent variables. The main finding is that the fact of receiving TAF reserves leads to a decreasing in liquidity risk exposures. Figures 6.b, 6.c and 6.d report the graphs of the estimated coefficients of the τ dummy variables and their correspondent standard errors, for the horizon of eight quarters after receiving the reserves for the first time.

Serial correlation is another issue that could affect our results. The consequence of not controlling for this source of bias would lead to non-standard standard errors. In order to control for serial correlation we follow Bertrand et al. (2004)[27]. The results reported in column (5) of Table 7 confirm the main findings: the TAF program decreases the liquidity risk positions of the banks.

Since our sample includes all commercial banks that handed in Call reports, and only a small fraction of those banks received TAF funding, we face a potential problem from the uneven distribution of the number of banks in the two groups. The results could be biased due to the larger amount of No TAF banks in the dataset. In order to alleviate this problem, we repeat the baseline estimations based on a smaller sample, obtained by using a matching approach. Specifically, we compare the two groups of banks ("TAF" and "No TAF") in 2007:Q3, before the beginning of the program, controlling for banks liquidity risk and cash levels and taking into account five neighbours[28]. The sample created in this way includes all

[27]A detailed description of the procedure followed is provided in Section B of the Appendix.

[28]Technically, we use a propensity score matching where we regress the TAF dummy variable on the liquidity risk measure and $CASH$. For each TAF bank we choose the 5 No TAF banks that have the closest propensity score. Since some No TAF banks are neighbours of more than one TAF bank, the total number

the banks that received at least once the reserves associated to the TAF program, and 1210 No TAF banks. As columns (6) and (7) of Table 7 show, the results are largely unvaried compared to our benchmark case. In Figure 5.b we depict the estimated coefficients on the τ's graphically. We can conclude that the results are not driven by the uneven composition of the sample.

The fact that the results obtained employing the matching approach do not diverge from those of the baseline model implies also that the selection bias is a minor issue in our analysis. The matching exercise allows us to control formally for this potential issue. As already emphasized, the results with respect to the baseline model do not change. The self selection bias has been checked also in another way, by employing a treatment model with binary explanatory variable[29]. Also in this case the results are confirmed, the TAF program decreases the level of liquidity risk.

The treatment model is also useful to neutralize another potential issue that can affect our results refers. Specifically, looking at changes in liquidity risk between two subsequent periods we cannot control for the pure account effect that reserves have on banks balance sheets, so that our findings could be biased. The results obtained by using the treatment model confirm that the TAF program has a pure effect on banks liquidity risk exposures that is not related to an accounting mechanism.

6.3 Discussion

We showed that the program was successful in detecting banks in liquidity needs and, at the same time, it helped in decreasing liquidity risk exposures. This implies that TAF-like programs are potentially appropriate during situations similar to the last crisis. Moreover, it also follows that the Fed behaved as lender of last resort, achieving its goal to inject liquidity

of banks is not five times the number of TAF banks.

[29]Detailed information about this methodology as well as the specification employed to estimate the model are provided in Section A of the Appendix.

in the inter bank credit market.

One relevant result of our study is that once controlled for several specific banks features, banks that received reserves reduce their funding liquidity risk more than the rest of the banks. If the Fed was behaving only as a lender of last resort, basically lending money to banks solvent but temporary illiquid, we would not be able to observe such effect. Our results suggest that something else happened. Specifically, we claim that there is an extra positive effect related to the fact of receiving the reserves that has not be taken into account.

A potential argument in favour of the relationship described above is that the TAF program represented the last source of financing for solvent but temporarily illiquid banks. In order to be eligible for future auctions these banks adopted a more virtuous funding liquidity risk behaviour than the rest of the banks. There exists also another potential explanation to support our result. Specifically, banks with liquidity needs that obtained the funds were presumably under informal monitoring of the regulatory authorities so that they were forced to adopt a behaviour, in terms of funding liquidity risk, more virtuous than the rest of the banks. This hypothesis can be supported only by using a counterargument. More precisely, even if the minimum interest rate proposed by Fed in the auctions was lower than the official discount window rate, and despite the fact that since Lehman Brothers' collapse all bids were accepted (so that from a theoretical view point there was a margin to make profits) only banks in funding liquidity distress bid and obtained for TAF loans while the others did not participate to the auctions.

Our contribution provides also some insights on what the authorities could do to prevent and control situations such as the last financial crisis. In particular, the results highlight the positive relationship between banks capital cushion and the level of funding liquidity risk. It follows that by observing only buffer is not sufficient to judge banking financial risk.

Therefore, if regulatory authorities treat capital cushion as the only element for controlling general banking financial soundness, they are missing a relevant component of the risk related to the liability term structure. In this perspective our contribution provides empirical justification to those arguments in favour of the introduction of measures for liquidity risk in financial regulation.

7 Conclusion

During the last financial crisis the Federal Reserve promoted several extraordinary actions, including the creation of a number of new facilities for auctioning short-term credit, with the general aim of sustaining the financial sector and of ensuring that financial institutions have adequate access to liquidity. One of these program has been the Term Auction Facility (TAF).

The objective of this study was two-fold: on the one hand, we analysed the characteristics of the banks that received TAF reserves and we compared them with those of the other banks; on the other hand, we measure the impact of TAF reserves on banks' liquidity risk. By acquiring this information is relevant to assess which type of bank obtained the credits, to understand and to measure the effects of the program in terms of funding liquidity risk exposures.

We contrast banks liquidity risk exposures in 2010:Q4 (three quarters after the end of the program) with those in 2007:Q3 (one quarter before the start of the program), by distinguishing between banks that received the reserves and the others. Moreover, for the banks that received the reserves we document their funding liquidity risk behaviour from twenty quarters before to ten quarters after receiving the reserves. A difference in difference approach has been employed to assess the impact of the program on changes in funding liquidity risk.

The results suggest that, on average, banks that obtained program reserves show higher liquidity risk indicators and that decrease liquidity risk exposures more than the rest of the banks. Several robustness checks confirm the main results.

Our results sustain the opinion that the TAF program was well designed so that only banks in major funding liquidity distress obtained the reserves. Moreover, they also support the view point such that the TAF program was able to decrease the liquidity risk at bank level, confuting the criticisms about its impact on liquidity risk.

One limitation of our contribution refers to the composition of the dataset employed. Specifically, we cannot distinguish between banks that participated and did not obtain the reserves from those banks that did participate at all. In further research it could be interesting to focus only on those banks that bid in the auctions of the program and perform a natural experiment exercise. Another potential application of our results could be to analyse the behaviour of the banks towards risk controlling for the amount of reserves received and the number of times that the bank participated and obtained reserves. This would allow to capture potential moral hazard behaviour of banks associated with the experience of past auctions.

Finally, another application could be to assess the impact of TAF program on banks balance–sheet as we already measured, at least in a primary version, in a companion paper.

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Appendices

A The selection bias issue

The selection bias issue occurs when one or more explanatory variables are correlated with the residuals. Therefore, these covariates are capturing "pure" effect that can be ascribed directly to them, but at the same time they capture as well the effect referring to the residual term. As a consequence we cannot interpret the estimated coefficient of these variables as their effect on the dependent variable.[30] In the case analysed in this paper if banks participate to TAF program because they have an unobservable higher propensity to risk, then TAF participation effect on risk could be overstated.

Assume that a generic econometric specification takes the following form:

$$Y = \alpha + \beta_1 X + \beta_2 D + \xi \tag{7}$$

where D is a dummy variable if individual i attends the program and zero otherwise. Assume that the fact of attending the program is affected by an unobservable characteristic. Assume first that the bias problem is not taken into account and a linear regression is estimated. The expected values of Y if $D = 1$ and when $D = 0$ take the following forms:

$$E(Y|D = 1) = \alpha + \beta_1 X + \beta_2 + E(\xi|D = 1) \tag{8}$$

and

$$E(Y|D = 0) = \alpha + \beta_1 X + E(\xi|D = 0) \tag{9}$$

respectively. Therefore the effect on the average value of Y is given by

[30] See also Cameron and Trivedi (2010)

$$E(Y|D=1) - E(Y|D=0) = \beta_2 + E(\xi|D=1) - E(\xi|D=0) \tag{10}$$

The estimated coefficient is capturing both the "pure" effect $\widehat{\beta}_2$ that can be ascribed to the fact of attending the program as well as the effects related to unobservable features $E(\xi|D = 1) - E(\xi|D = 0)$. One way to solve for this potential issue is to estimate a treatment effect model with binary endogenous regressor. They are based on the simultaneous estimation of two regressions.

On the one hand, a probit model is estimated in order to compute the predicted probability of participating to the program controlling for a set of potential explanatory variables.

$$D^* = Z\theta + \epsilon \tag{11}$$

where D^* is a latent variable, Z is the vector of the observable features affecting the fact of participating and ϵ are the residual. We assume that the error terms of the probit and the linear model, ϵ and ξ, respectively are bivariate normally distributed with zero mean and covariance matrix

$$\begin{bmatrix} 1 & \rho\sigma_\xi \\ \rho\sigma_\xi & \sigma_\xi \end{bmatrix}$$

Finally,

$$D = \begin{cases} 1 & \text{if } D^* > 0 \\ 0 & \text{if } D^* \leq 0 \end{cases}$$

It follows that

$$P(D=1) = \Phi(Z\theta) \quad \text{and} \quad P(D=0) = 1 - \Phi(Z\theta)$$

and from the joint density of the bivariate normally distributed variables, equations (8) and

(9) can be written as

$$E(Y|D=1) = \alpha + \beta_1 X + \beta_2 + \rho\sigma_\xi \frac{\phi(Z\theta)}{\Phi(Z\theta)}$$

$$E(Y|D=0) = \alpha + \beta_1 X - \rho\sigma_\xi \frac{\phi(Z\theta)}{1-\Phi(Z\theta)}$$

The average treatment effect is therefore the difference,

$$E(Y|D=1) - E(Y|D=0) = \beta_2 + \rho\sigma_\xi \frac{\phi(Z\theta)}{\Phi(Z\theta)[1-\Phi(Z\theta)]} \tag{12}$$

where ρ is the correlation between the two error terms and σ_ξ is the noise term standard error of the linear regression. By using the treatment effect model with binary endogenous regressor we are able to capture the effects of unobservable features captured by the treatment variable and therefore to exactly measure the "pure" effect of participating to the program. The "cost" of adopting this approach is the strong assumption about the distribution of the error terms. An alternative approach that does not require previous assumption is to run a two-step estimation, computing robust standard error.

A.1 The treatment effect model with binary explanatory variable

It is possible to control for potential selection bias by estimating a treatment effect model with binary endogenous regressor, using a two-period panel data set. In this way, it is possible to control for potential selection bias that could arise if banks that received the reserves have ex ante unobservable features that make them different with respect to the other banks, and that affect their decision to participate to the auctions.

According to equations (7) and (11), the model estimated in the robustness part takes the following form:

$$\begin{aligned} \Delta ST\,LIAB\,/\,ST\,ASSETS_{i,after} = {} & \beta_0 + \beta_1\,TAF_i + \beta_2\,BUFFER_i + \beta_3 SIZE_i + \\ & + \beta_4\,PF\,RISK_i + \beta_5\,CASH_i + \beta_6\,NPTL + \\ & + \beta_7\,ROA_i + \xi_i \end{aligned} \tag{13}$$

$$TAF_i = \begin{cases} 1 & \text{if } TAF_i^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

where the unobserved latent variable follows the specification below:

$$\begin{aligned} TAF_i^* = {} & \theta_0 + \theta_1\,ST\,LIAB/ST\,ASSETS_{i,\text{2007Q3}} + \theta_2\,CASH_i + \\ & + \theta_3\,(ST\,LIAB/ST\,ASSETS_{i,\text{2007Q2}} - ST\,LIAB/ST\,ASSETS_{i,\text{2005Q1}}) + \epsilon_i \end{aligned} \tag{14}$$

The explanatory variables in equations (13) and (14) are measured prior to the beginning of the program, by the value of the variables in 2007:Q3. The dependent variable in equation (13) is measured as the difference between 2010:Q4 and 2007:Q3, as in the baseline case. By studying the TAF effects on liquidity risk changes between before the start and after the end of the program, we adopt a long run perspective, so that we "neutralize" potential biases due to accounting effects of the TAF program on banks balance sheets.

As previously discussed in subsection 3.1, the aim of the TAF program was to inject liquidity in the inter bank credit market by providing reserves to banks in financial distress. Moreover, this result had to be achieved by limiting potential "stigma" effect related to this type of financial aid. Therefore, the way of providing reserves had been based on an auction system. It follows that the goal of the auction was not to maximize Fed profits but to reduce at most the potential "stigma" effect. All these considerations convinced us to model the participation equation (i.e. equation (14)) by taking into account funding liquidity distress indicators, and disregarding those variables measuring banks competitiveness, useful in a normal auction system for winning the auction. Moreover, in order to identify the model, we also include the *increase* of liquidity risk prior to the TAF program, between 2005:Q1 and 2007:Q2. A bank that changed the financing model in this period might be more prone to a sudden drought on the interbank market.

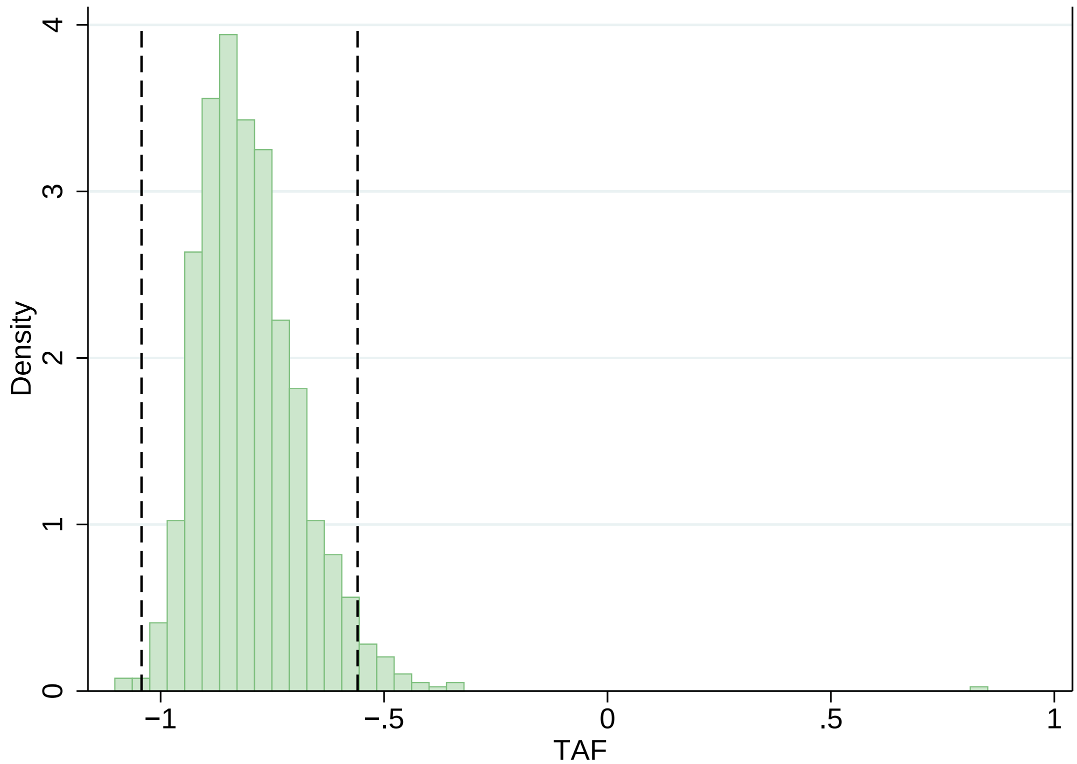
Equation (13) takes into account the relationship between the ex post liquidity risk level, approximated in the baseline model by $\Delta ST\,LIAB/ST\,ASSETS$ and the TAF dummy variable, controlling for a set of covariates. According to the specification of the model we are able to test whether we are facing a selection bias, implying that, if not controlled, the TAF dummy would capture spurious effects. Formally, this information is provided by the estimated coefficient on λ (which is defined in the following way: $\lambda \equiv \rho\sigma_{\xi}$). For the regression shown in column (9) of Table 7, the estimated λ is equal to .188, with an estimated standard error of .049. We can therefore reject the null hypothesis that the estimated coefficient is zero (χ^2 statistic is 13.40). It follows that there exists a selection bias that we have to control for.

In order to alleviate the potential problem of the uneven distribution of TAF and No

TAF banks, we run a Monte Carlo simulation. In each iteration, the sample includes all TAF banks and a randomly chosen subset of No TAF banks. The graph in Figure 4 shows the distribution of the estimate of TAF reserves as well as the bounds of the corresponding confidence interval at 95% obtained by repeating 1000 times the estimation and by using a sample of around 1050 observation randomly. Before the estimation we check whether the mean of all used variables of the chosen sub-sample are within a narrow band around the mean of the entire sample (we use 0.5 times the standard deviation as threshold).

The results show that banks that benefited of the the TAF reserves decrease liquidity risk exposures more that the rest of the banks. Moreover, we also find that a high level of liquidity in 2007:Q3 increases the participation to the program. Also, we find that banks with a larger share of cash are likely to participate. Finally, the increase in liquidity risk between 2005:Q1 and 2007:Q2 does not have a significant impact on the participation.

Figure 4: TAF estimated coefficient obtained from a Monte Carlo simulation



B Serial correlation issue

The way suggested by Bertrand et al. (2004) in order to control for non-standard standard errors is to ignore time series information. Due to the fact the reserves are received in different periods in time we have to proceed in the following way. First, we estimate a modified version of the specification in equation (6), where we leave out $TREAT$:

$$\begin{aligned}\Delta\, Liq.\, Risk_{i,t} = \alpha_i + \delta_t\, + \beta_0\, Liq.\, Risk_{i,t-1} \\ \beta_1\, BUFFER_{i,t-1} + \beta_2\, SIZE_{i,t-1} + \beta_3\, CASH_{i,t-1} + \\ \beta_4\, NPTL_{i,t-1} + \beta_5\, ROA_{i,t-1} + \epsilon_i\end{aligned} \tag{15}$$

Second, we define e the residual obtained by running the previous regression. Third, focusing only on the residuals for those banks that received the reserves, we can distinguish between periods before and after each bank obtained reserves for the first time. We take the average values of the residuals for each period j (before and after), so that we obtain $\overline{e}_{i\,|\,TAF\,bank,\,j}$. Finally, the estimated effect of the program on the funding liquidity risk and the corresponding standard error can be obtained by running the following 2 period panel regression:

$$\overline{e}_{i\,|\,TAF\,bank,\,j} = \lambda_0 + \lambda_1\, TREAT_{i,\,j} + \xi_{i,\,j} \tag{16}$$

C Tables

Table 3: Summary statistics

	Before						After					
	No TAF		TAF		Total		No TAF		TAF		Total	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
ST LIAB / ST ASSETS	-4.421	.773	-4.253	.849	-4.415	.777	-4.471	.730	-4.404	.892	-4.469	.736
ST LIAB / TOT LIAB	.00405	.00133	.00414	.00144	.00405	.00134	.00327	.00118	.00304	.00124	.00326	.00118
NET LIAB	3.933	18.81	8.379	19.22	4.094	18.85	1.927	16.04	3.128	16.00	1.971	16.04
ST LIAB / PF RISK 0%	-1.410	1.297	-1.187	1.621	-1.402	1.310	-2.816	1.383	-3.127	1.459	-2.828	1.387
LIQUIDITY	.202	.141	.156	.119	.201	.140	.207	.146	.179	.126	.206	.145
CASH	.0383	.0421	.0288	.0354	.0380	.0419	.0863	.0838	.0589	.0614	.0853	.0833
BUFFER	.0572	.0763	.0481	.0837	.0569	.0766	.0416	.0418	.0358	.0318	.0414	.0415
SIZE	11.88	1.256	14.06	2.139	11.96	1.360	12.04	1.221	14.14	2.090	12.12	1.324
ROA	.00804	.0113	.0102	.00976	.00811	.0112	.00427	.0161	.000865	.0225	.00414	.0164
NPTL	.0236	.0245	.0173	.0165	.0234	.0243	.0448	.0478	.0559	.0506	.0452	.0480
TOT LOANS	.647	.152	.683	.144	.648	.152	.610	.144	.652	.133	.612	.144
CI LOANS	.148	.108	.176	.130	.149	.109	.137	.0992	.158	.114	.138	.0998
REAL EST LOANS	.686	.195	.702	.202	.687	.195	.711	.188	.718	.210	.711	.189
INDIV LOANS	.0763	.0919	.0724	.144	.0761	.0943	.0655	.0887	.0762	.181	.0659	.0938
AGRI LOANS	.0723	.125	.0172	.0540	.0703	.124	.0717	.124	.0176	.0553	.0697	.122
PF RISK	.693	.127	.759	.115	.695	.128	.650	.117	.699	.108	.652	.117
0% PF RISK	.0257	.0484	.0248	.0612	.0257	.0489	.0804	.0868	.0862	.0859	.0806	.0868
20% PF RISK	.250	.146	.186	.117	.248	.145	.226	.141	.175	.101	.224	.141
50% PF RISK	.161	.121	.134	.100	.160	.121	.170	.118	.135	.0846	.169	.117
100% PF RISK	.563	.173	.654	.155	.567	.173	.524	.157	.604	.136	.527	.157
Observations	7520		271		7791		6738		251		6989	

Before period refers to 2007:Q3, After period refers to 2010:Q4.

Table 4: Average differences tests: Before and After

Variable	Before	After	No TAF	TAF	Diff in Diff
	(1)	(2)	(3)	(4)	(5)
ST LIAB / ST ASSETS	.208***	.071	-.040***	-.177**	-.137*
	(.057)	(.057)	(.013)	(.080)	(.081)
ST LIAB / TOT LIAB	.000	-.000***	-.001***	-.001***	-.000***
	(.000)	(.000)	(.000)	(.000)	(.000)
NET LIAB	5.432***	1.735*	-1.772***	-5.469***	-3.697**
	(1.189)	(1.040)	(.313)	(1.548)	(1.579)
ST LIAB / PF RISK 0%	.230**	-.309***	-1.402***	-1.941***	-.538***
	(.101)	(.094)	(.023)	(.136)	(.138)
CASH	-.014***	-.031***	.048***	.031***	-.017***
	(.002)	(.004)	(.001)	(.004)	(.005)
BUFFER	-.021***	-.012***	-.017***	-.009	.008
	(.005)	(.004)	(.002)	(.006)	(.007)
SIZE	2.244***	2.143***	.176***	.074	-.101
	(.131)	(.134)	(.021)	(.186)	(.187)
ROA	-.000	-.005***	-.004***	-.010***	-.005***
	(.001)	(.001)	(.001)	(.002)	(.002)
NPTL	-.007***	.012***	.021***	.039***	.018***
	(.001)	(.003)	(.001)	(.003)	(.003)
PF RISK	.071***	.051***	-.042***	-.062***	-.020**
	(.007)	(.007)	(.002)	(.010)	(.010)

The results are based on the estimation of eq. (2), according to table 2.

Table 5: Correlation Matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	ST LIAB / ST ASSETS	1										
(2)	ST LIAB / TOT LIAB	.453	1									
(3)	ST NET LIAB	.901	.547	1								
(4)	ST LIAB / PF RISK 0%	.238	.460	.228	1							
(5)	SIZE	.200	.00860	.198	.0270	1						
(6)	CASH	-.187	-.102	-.208	- .157	-.222	1					
(7)	PF RISK	-.0430	.185	-.0177	.380	.234	-.254	1				
(8)	TOT LOANS	.137	.210	.134	.333	.166	-.250	.818	1			
(9)	BUFFER	-.362	-.0727	-.339	-.0869	-.267	.124	-.190	-.296	1		
(10)	ROA	.0610	-.0260	.0384	.00107	.189	-.0159	.111	.128	-.362	1	
(11)	NPTL	.0339	.0751	.0468	.0118	-.0926	.00203	-.0256	.0178	-.0862	-.0498	1

The correlations are calculated based on period 2007:Q3.

Table 6: Baseline model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Dependent variable: $\Delta ST\ LIAB\ /\ ST\ ASSETS$									
τ_0	-.039	-.050*	-.051*	-.049	-.048					
	(.026)	(.025)	(.025)	(.026)	(.025)					
τ_1	-.057*	-.073**	-.074**	-.071**	-.070**					
	(.026)	(.026)	(.026)	(.026)	(.026)					
τ_2	-.031	-.049**	-.049**	-.047**	-.046*					
	(.018)	(.018)	(.018)	(.018)	(.018)					
τ_3	-.110***	-.129***	-.129***	-.127***	-.126***					
	(.027)	(.027)	(.027)	(.027)	(.027)					
τ_4	-.099***	-.120***	-.119***	-.118***	-.118***					
	(.019)	(.019)	(.019)	(.019)	(.019)					
τ_5	-.097***	-.120***	-.118***	-.117***	-.118***					
	(.019)	(.019)	(.019)	(.019)	(.019)					
τ_6	-.088***	-.114***	-.112***	-.110***	-.111***					
	(.021)	(.021)	(.021)	(.020)	(.021)					
τ_7	-.076**	-.104***	-.101***	-.100***	-.101***					
	(.025)	(.025)	(.025)	(.025)	(.025)					
τ_8	-.069*	-.102***	-.099***	-.096***	-.098***					
	(.029)	(.029)	(.029)	(.029)	(.029)					
TREAT						-.072***	-.092***	-.092***	-.090***	-.090***
						(.014)	(.013)	(.013)	(.013)	(.014)
L.ST LIAB / ST ASSETS	-.341***	-.341***	-.341***	-.341***	-.340***	-.341***	-.341***	-.340***	-.341***	-.340***
	(.007)	(.007)	(.007)	(.007)	(.008)	(.007)	(.007)	(.007)	(.007)	(.008)
L.BUFFER		.203***	.195***	.175***	.237***		.215***	.195***	.175***	.237***
		(.049)	(.049)	(.049)	(.048)		(.048)	(.049)	(.049)	(.048)
L.SIZE		.063***	.065***	.061***	.066***		.062***	.065***	.061***	.066***
		(.008)	(.008)	(.008)	(.008)		(.008)	(.008)	(.008)	(.008)
L.CASH		-.342***	-.307***	-.341***			-.339***	-.306***	-.341***	
		(.035)	(.036)	(.035)			(.035)	(.036)	(.035)	
L.LIQUIDITY					.093**					.093**
					(.029)					(.029)
L.PF RISK		-.243***			-.142***		-.246***			-.142***
		(.024)			(.027)		(.024)			(.027)
L.NPTL		.357***	.392***	.360***	.356***		.392***	.392***	.359***	.356***
		(.045)	(.045)	(.045)	(.045)		(.040)	(.045)	(.045)	(.045)
L.ROA		-.334	-.368	-.307	-.313			-.364	-.303	-.309
		(.218)	(.219)	(.219)	(.217)			(.219)	(.219)	(.217)
L.PF RISK 20			.109***					.110***		
			(.031)					(.031)		
L.PF RISK 50			.013					.014		
			(.040)					(.040)		
L.PF RISK 100			-.109**					-.108**		
			(.036)					(.036)		
L.TOT LOANS				-.207***					-.208***	
				(.021)					(.021)	
L.R EST LOANS				-.014					-.015	
				(.133)					(.133)	
L.INDIV LOANS				.027					.027	
				(.150)					(.150)	
L.AGRI LOANS				-.190					-.190	
				(.134)					(.134)	
L.CI LOANS				-.092					-.092	
				(.142)					(.142)	
Constant	-1.543***	-2.111***	-2.265***	-2.083***	-2.250***	-1.543***	-2.100***	-2.264***	-2.080***	-2.248***
	(.031)	(.099)	(.110)	(.151)	(.103)	(.031)	(.099)	(.110)	(.151)	(.103)
$\sum_\kappa \tau_\kappa$	-.717***	-1.066***	-1.045 ***	-1.011***	-1.030***					
p-Value	.0043	.0000	.0000	.0001	.0001					
Observations	245530	244785	244785	244785	244785	245530	244785	244785	244785	244785

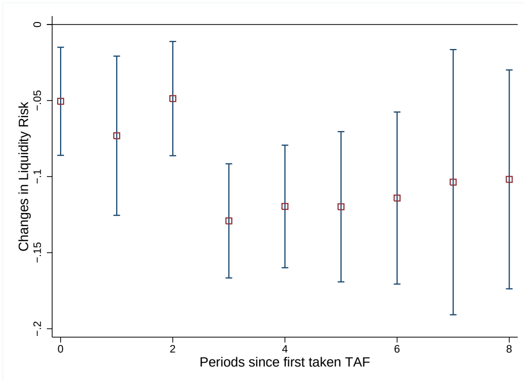
Notes: Bank clustered s.e. in parentheses. *** = $p < .01$, ** = $p < .05$, * = $p < .1$. All regressions include bank and time fixed effects. In columns (1) to (5) we include 13 τ_κ ($\kappa = 0...12$) and show the first 9. The p-Value refers to a t-test with null hypothesis that the sum of all τ's is zero.

Table 7: Robustness checks

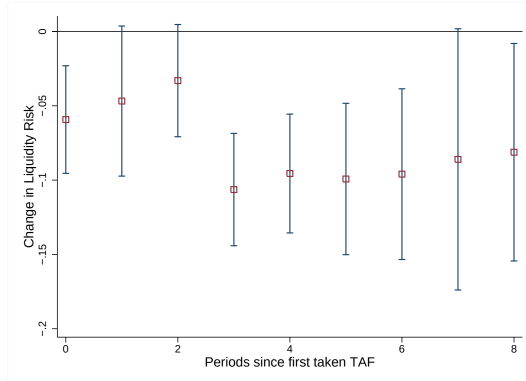
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable (see Notes)	a	b	c	d	a	a	a	a	a
τ_0	-.050*	-.686	-.006	.003		-.059*		-.046	
	(.025)	(.369)	(.045)	(.003)		(.025)		(.026)	
τ_1	-.073**	-1.779***	-.081	-.010**		-.047		-.070**	
	(.026)	(.445)	(.058)	(.003)		(.026)		(.027)	
τ_2	-.049**	-1.271**	-.016	-.003		-.033		-.051**	
	(.018)	(.431)	(.050)	(.004)		(.018)		(.018)	
τ_3	-.129***	-3.081***	-.248***	-.015***		-.106***		-.125***	
	(.027)	(.516)	(.048)	(.004)		(.026)		(.027)	
τ_4	-.120***	-2.442***	-.113*	-.014***		-.096***		-.113***	
	(.019)	(.394)	(.045)	(.003)		(.019)		(.019)	
τ_5	-.120***	-2.708***	-.145**	-.019***		-.099***		-.119***	
	(.019)	(.468)	(.049)	(.003)		(.019)		(.019)	
τ_6	-.114***	-2.297***	-.192***	-.017***		-.096***		-.111***	
	(.021)	(.439)	(.047)	(.003)		(.020)		(.021)	
τ_7	-.104***	-2.427***	-.084*	-.018***		-.086***		-.101***	
	(.025)	(.458)	(.043)	(.004)		(.026)		(.026)	
τ_8	-.102***	-2.405***	-.238	-.016***		-.081**		-.107***	
	(.029)	(.595)	(.125)	(.005)		(.029)		(.028)	
TREAT					-.090***		-.075***		-.453***
					(.015)		(.013)		(.121)
L.ST LIAB / ST ASSETS	-.341***				-.340***	-.318***	-.318***	-.341***	
	(.007)				(.007)	(.013)	(.013)	(.007)	
L.NET LIAB		-.266***							
		(.003)							
L.ST LIAB / PF RISK 0			-.295***						
			(.004)						
L.ST LIAB / TOT LIAB				-.256***					
				(.003)					
L.BUFFER	.203***	4.007***	.876***	.033***	.200***	.130	.129	.203***	1.235***
	(.049)	(.882)	(.073)	(.007)	(.049)	(.121)	(.120)	(.049)	(.341)
L.SIZE	.063***	1.659***	-.049***	.008***	.060***	.046**	.045**	.063***	-.033***
	(.008)	(.147)	(.012)	(.001)	(.008)	(.017)	(.017)	(.008)	(.007)
L.PF RISK	-.243***	-7.422***	.486***	.026***	-.243***	-.254***	-.254***	-.243***	.018
	(.024)	(.462)	(.044)	(.003)	(.024)	(.056)	(.056)	(.024)	(.081)
L.CASH	-.342***	-6.915***	.065	.008	-.337***	-.374***	-.376***	-.342***	.201
	(.035)	(.813)	(.062)	(.004)	(.035)	(.110)	(.110)	(.035)	(.201)
L.NPTL	.357***	10.107***	-1.037***	.025***	.344***	.252*	.251*	.359***	1.548***
	(.045)	(1.069)	(.093)	(.007)	(.045)	(.102)	(.102)	(.045)	(.372)
L.ROA	-.334	-14.036***	2.091***	-.068**	-.297	-.226	-.211	-.332	4.647*
	(.218)	(3.563)	(.320)	(.026)	(.218)	(.443)	(.440)	(.218)	(2.536)
Constant	-2.111***	-14.354***	-.388**	-.024*	-2.076***	-1.761***	-1.752***	-2.109***	.187*
	(.099)	(1.753)	(.144)	(.011)	(.099)	(.216)	(.216)	(.099)	(.109)
$\sum_\kappa \tau_\kappa$	-1.066***	-26.29***	-1.811***	-.147***		-.835***		-1.154***	
p-Value	.0000	.0000	.0002	.0001		.0009		.0000	
Observations	244785	245636	236316	244785	244785	45350	45350	244611	7188

Notes: Bank clustered s.e. in parentheses. *** = $p < .01$, ** = $p < .05$, * = $p < .1$. The dependent variables are the difference of a: ST LIAB / ST ASSETS; b: ST LIAB / TOT LIAB; c: ST NET LIAB; and d: ST LIAB / PF RISK 0%. The TREAT coefficient in column (5) refers to the estimates of equation (16). Columns (6) and (7) are estimated using the matched sample. In column (8) we drop the banks that are most connected to Lehman Brothers (see Section 6.2). Column (9) shows the regression results of the risk equation from the treatment model. The coefficient shown in the TREAT line refers to the TAF dummy as defined in Section A of the Appendix. The regression results of the selection equation are available upon request. All regressions include bank and time fixed effects. In columns (1) to (4), (6) and (8) we include 13 τ_κ ($\kappa = 0...12$) and show the first 9. The p-Value refers to a t-test with null hypothesis that the sum of all τ's is zero.

Figure 5: Estimates of τ's and confidence interval

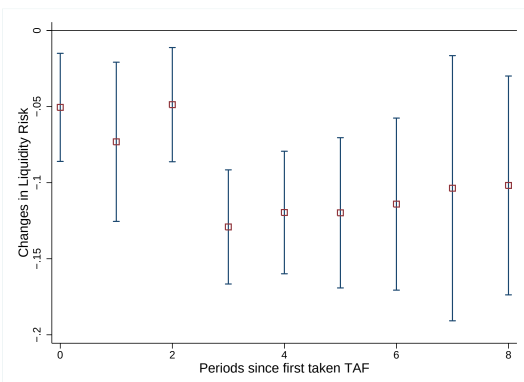


(a) Unmatched

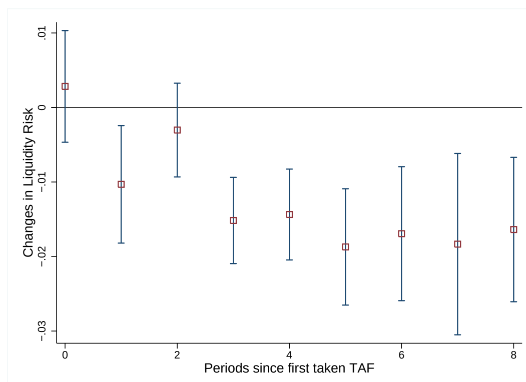


(b) Matched

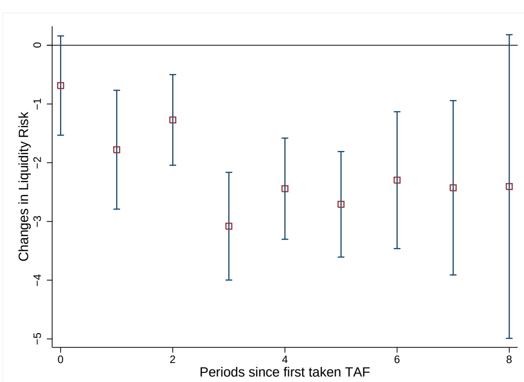
Figure 6: Estimates of τ's and confidence interval, unmatched



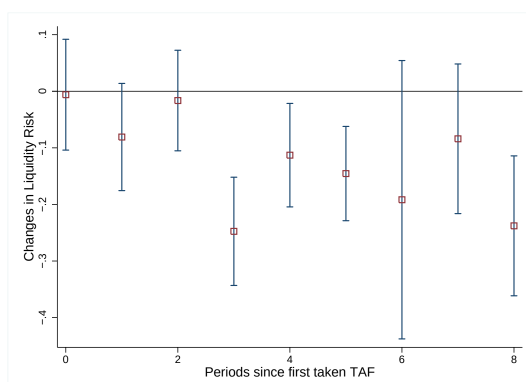
(a) ST Liabilities / ST Assets



(b) ST Liabilities / Total Liabilities



(c) ST Net Liabilities



(d) ST Liabilities / PF Risk 0%